Scoping and Gap Analysis Report for Activity 3 – Agriculture Sector

ICAT Initiative for Climate Action Transparency

Initiative for Climate Action Transparency – ICAT
Scoping and Gap Analysis Report for Activity 3 – Agriculture Sector

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Abbreviations

AFOLU	Agriculture, Forestry and Other Land Use
BTRs	Biennial transparency reports
CCU	Climate Change Unit
CSER	Centre for Sustainable Energy Research
CSO	Central Statistics Office
DAES	Department of Agricultural and Extension Services
ECGA	Eswatini Cane Growers Association
ECB	Eswatini Cotton Board
ESA	Eswatini Sugar Association
ESAFF	Eastern and Southern Africa small-scale Farmers Forum
EFU	Eswatini Farmers Union
ERA	Eswatini Revenue Authority
EWSC	Eswatini Water Services Corporation
GDP	Gross Domestic Product
GHGs	Greenhouse gases
IPCC	Intergovernmental Panel on Climate Change
MoA	Ministry of Agriculture
MOUs	Memoranda of Understanding
MTEA	Ministry of Tourism and Environmental Affairs
NAMBOARD	National Agricultural Marketing Board
NMC	National Maize Corporation
RES	Royal Eswatini Sugar Corporation
SNL	Swazi Nation Land
SWAFCU	Swaziland Farmers' Cooperative Union
T2EF	Tier 2 Emissions Factor
UNESWA	University of Eswatini

Executive summary

This is a scoping and gap analysis report for the agriculture sector in the Kingdom of Eswatini. It profiles the status of agriculture data in the country, for both livestock and non-livestock sectors, which was done in close consultation with key stakeholders, including the parent ministry, the Ministry of Agriculture (MoA) and inventory compilers. The analysis further took a leaf from the recently completed national study that was aimed at developing Tier 2 Greenhouse gas (GHG) inventory in the livestock sector and assessing the potential to reduce GHGs across the agriculture sector in the Kingdom. The report summarises identified data requirements for Tier 2 calculations for both the sectors under agriculture, as well as identified appropriate data sources, data suppliers, and data gaps that need to be attended for improved agriculture inventory. Finally, it outlines possible protocols needed to acquire the missing data.

Introduction

The Agriculture, Forestry and Other Land Use (AFOLU) sector was the dominant sector in the greenhouse gas (GHG) emissions (computed using Tier 1[1] methods) for Eswatini in 2018 (Figure 1), contributing 48%, while the next highest sector, Energy, contributed 40% (Dlamini et al., 2020). Moreover, agriculture remains a major contributor to the country's economy through the provision of food, jobs and financial security.

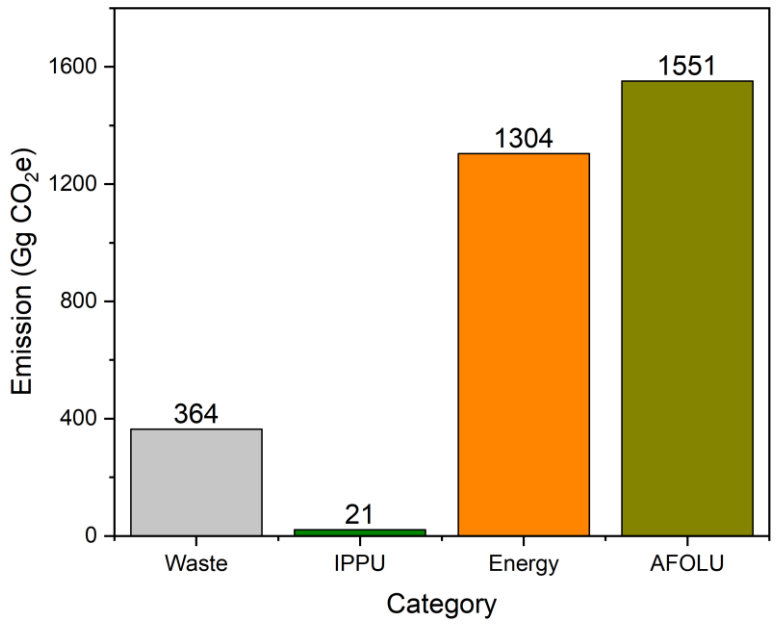

Figure 1: Eswatini's total GHG emissions by sector for the year 2018

In 2018, the AFOLU sector was a net emitter at 1551.14 Gg CO_2 equivalent (e) in Eswatini compared to 1990 where the country was a sink contributing -1090.61 Gg CO_2e. The emission increased relative to activities and management practices such as deforestation through forest conversions to cropland and grassland, biomass burning, emissions from livestock enteric and manure management and nitrogen additions to soil (Table 1). On gas-by-gas basis, N_20 had the greater share of the AFOLU reported at 41.7 % of the AFOLU sector emissions, followed by CO_2 (31.1 %) and CH_4 (27.2%). Within the AFOLU sector, the land category was the main emission source, consisting 59% of the AFOLU emission. The rest were shared among aggregated sources and non-CO_2 emissions on land (13%) and livestock (24%). Harvested wood products category was the only sink in the sector, with -4% contributions.

[1] Tier 1 methods are designed to be the simplest to use, for which equations and default parameter are provided in the 2006 IPCC guidelines. Country-specific activity data are needed, but for this Tier, globally available sources of activity data may be used.

Table 1: AFOLU key categories for the Kingdom of Eswatini

Greenhouse gas source and sink categories	Gas	Emissions/removal (Gg CO_2e)		
		1990	***2015***	***2018***
Croplands	CO_2	175.20	1044.81	930.29
Grasslands	CO_2	248.35	588.21	575.50
Enteric fermentation	CH_4	504.45	442.82	383.41
Forest lands	CO_2	-2 185.91	-811.50	-290.68
Manure management	N_2O	189.39	173.91	151.18
Direct N_2O from managed soils	N_2O	339.20	333.42	306.41
Indirect N_2O from manure management	N_2O	132.46	113.67	96.56
Wetlands	CO_2	4.41	66.57	64.95

The AFOLU sector remains a key component of the Eswatini economy, collectively accounting for more than 13% of the country's Gross Domestic Product (GDP) (Central Bank of Eswatini, 2021). A majority of the high-value agricultural crops (sugarcane, forestry, and citrus fruits) are grown on Title Deed Land (TDL) and leased Swazi Nation Land (SNL) where there are high levels of investment and irrigation, and high productivity. However, about 75% of the local population reside in rural Swazi Nation Land (SNL) areas and is engaged in subsistence agriculture. Notably, both subsistence and commercial farmers practice livestock rearing and crop production (maize for subsistence and sugarcane for commercial, respectively). The socio-economic and land use dynamics have implications on the country's carbon profile, hence the need for continuous assessment and monitoring.

The increasing concerns over global climate change and pollution has seen a global drive to reduce the overall environmental impact of animal and crop production, these being the adaptation and mitigation (IPCC, 2021; Jackson et al., 2020). Such efforts and interventions are targeting improved/enhanced management-based mitigation and adaptation approaches for reduced GHG emissions across the sector.

The 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories are the guiding greenhouse gas (GHG) documents for the Kingdom of Eswatini to prepare national inventories, national communications and biennial transparency reports (BTRs). The guidelines provide several methodological options for estimating GHG emissions which are structured in the form of three tiers (Tier 1, 2, and 3) that describe and connect the various levels of detail at which GHG emission estimates can be made. Moving to higher tiers improves the accuracy of the inventory and reduces uncertainty, however, the complexity and resources required for conducting inventories also increases for higher tiers (Tier 2 and 3) (IPCC, 2006). The methods are distinguished between the tiers as follows:

- **Tier 1**: The methods are designed to be the simplest to use, for which equations and default parameters are provided in the 2006 IPCC guidelines. Country-specific activity data are needed, but for Tier 1, globally available sources of activity data may be used.
- **Tier 2**: These methods apply country-specific emission factors and use IPCC default equations and parameters. Higher temporal and spatial resolution and more disaggregated activity data are typically used in Tier 2 to correspond with country-defined coefficients for specific regions and specialized land-use or livestock categories. Tier 2 provides better accuracy than Tier 1 with moderate data and resource requirements.
- **Tier 3**: These methods are higher order methods, including equations and inventory measurement systems tailored to address national circumstances, repeated over time, and driven by high-resolution activity data and disaggregated at a sub-national level. They provide the highest accuracy while having less uncertainty. Due to their comprehensive nature, they demand the most in terms of data and resources.

This project, therefore, aims to develop robust sustainable data collection processes, including institutional arrangements, and improved Tier 2 data for future inventory compilation. It is meant to contribute towards ongoing efforts to improve the availability, collection and quality of data required for estimating emissions in the Agriculture, Forestry and Other Land Use (AFOLU) sector and to enable Eswatini to meet its enhanced international reporting standard requirements.

Data requirements for the agriculture sector under Tier 2 GHG inventory compilation

Under the livestock sector, Tier 2 approaches require more detailed information (as already highlighted in the preceding sections) on different types of livestock in a country, and data on livestock weight, weight gain, feed digestibility, milk yield and other factors reflecting management practices and animal performance (Wlikes & van Dijk, 2018). These data are used to estimate feed intake required by the animals to maintain the specified level of performance. Intake is then converted to methane emissions by multiplying energy intake by a methane conversion factor. This conversion factor changes with the quality of an animal's diet. A Tier 2 approach is, therefore, better able to reflect management practices, diets and animal productivity in different production systems or regions of a country. Moreover, the key challenge in the compilation of GHG inventory in the Kingdom of Eswatini, like many other developing regions, has been due to limited and/or unavailability of activity data (Dlamini et al., 2020).

In addition, for the non-livestock sector, data required include:

- Amount of applied synthetic N fertilizers
- Amount of applied organic N applied as fertilizer (e.g., animal manure, compost, sewage sludge, rendering waste, etc.)
- Amount of urine and dung N deposited on pasture, range, and paddock by grazing animals
- Amount of crop residue N (above-ground and below-ground) added to soils
- N mineralization associated with loss of soil organic matter resulting from change of land use or management of mineral soils
- Area of drainage/management of organic soils
- Amount of carbonates applied to soils in the form of lime (e.g., calcic limestone or dolomite)

Ideally, the applied fertilizer, lime, urea management practices on manure, and drainage of organic soils, ought to be in spatial format rather than simply national totals of each, as is primarily the case under the Tier 1 approach.

Data collection protocols and existing institutional arrangements

The Kingdom of Eswatini has completed its latest GHG inventory compilation and is now in the process of finalising its Fourth National Communication report. From the GHG inventory compilation, key category analyses identified enteric fermentation, manure management, direct N_2O from managed soils and indirect N_2O from manure management as key categories among other GHG categories (which were still under the AFOLU sector). As a result, several improvements were suggested, among which were enhanced data collection and institutional arrangements, especially in these key categories.

Existing institutional arrangements in Eswatini

In terms of existing institutional arrangement, GHG inventory compilation falls within the portfolio of the Climate Change Unit (CCU), in the Ministry of Tourism and Environmental Affairs (MTEA). In the year 2010, MTEA established the National Climate Change Coordination (NCCC), a multi-stakeholder group, through the country's cabinet (Mhlanga-Ndlovu & Mhlanga, 2019). It constituted over 30 members from different institutions. The mandate of NCCC is to coordinate climate affairs of Eswatini by ensuring that climate change is integrated into the broader development agenda, and to guide development plans, programmes, and projects in response to climate change. Figure 2 below outlines the current NCCC governance structure.

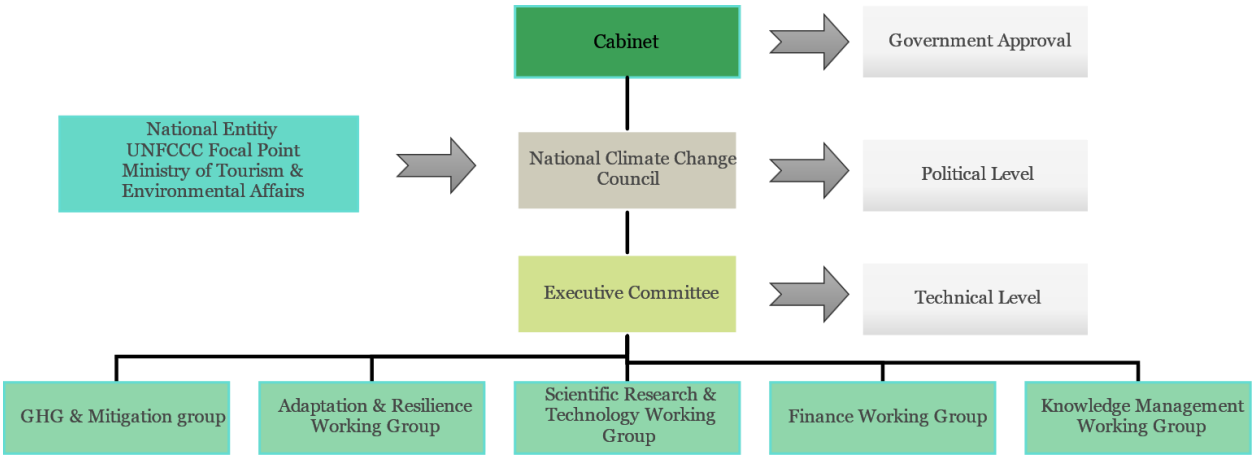

Figure 2: Current National Climate Change Coordination (NCCC, 2015)

The hierarchy of the NCCC places Cabinet as the highest authority, receiving updates from the National Climate Change Council, which is the political level that include the UNFCCC focal point who currently is housed in the MTEA, among other members. Under the National Climate Change Council is the Executive Committee, which is at a technical level. This committee overseers five technical working groups, namely, the GHG and Mitigation group, Adaptation and Resilience Group, Scientific Research and Technology Working Group, Finance Working Group, and Knowledge Management Working Group.

The national inventory coordinator oversees the whole process of GHG inventory compilation, and the Unit is responsible for the management of the inventory database. The Kingdom has greatly invested in the training and development of national experts who are engaged in the GHG inventory compilation. Specifically for the Agriculture sector, these consultants are from the University of Eswatini (UNESWA). The Kingdom, through the CCU, also established a technical working group made up of sector experts from relevant government departments, units, parastatals, agencies, private sectors and NGOs, whose role is to offer support, guidance, and expertise during the entire compilation process. The last component is the inventory data providers.

Data sources, collectors, and providers for the livestock sector

Livestock data is annually collected and reported by the Ministry of Agriculture (MoA), through its Department of Livestock and Veterinary Services (DLVS). The Livestock Services is mandated with providing livestock extension services, management of government ranches, animal nutrition and range management extension, as well as livestock marketing and markets information. The Veterinary Services is mandated with promoting animal health and welfare while creating conducive conditions for economic animal production. For the livestock sector, the main sources of data are summarised in Table 2 below.

Table 2: Main data providers for the livestock sector in Eswatini

Institution	Department/Unit	Data
MoA	Department of Veterinary and Livestock Services	National livestock population (cattle, goats, sheep, pigs, poultry, horses and donkeys)
Central Statistics Office	Agriculture Data Unit	National census years data on livestock population (cattle, goats, sheep, pigs, poultry, horses and donkeys)
FAO		Productive data
King's Office	Livestock Section	Livestock populations under Tibiyo TakaNgwane farms
Eswatini Dairy Board		National dairy cattle population Milk yield
Eswatini Meat Industries		Manure management (abattoirs)
Eswatini Meat Wholesalers		Manure management (abattoirs)
Private Sector/Farms (Including IYSIS Farms)		Livestock populations Productive data Feed basket
Association of Livestock Farmers (Owned by communities at Maloma using Tibiyo Farm)		Livestock populations Productive data Feed basket
Smart Cattle Farmers		Livestock populations Productive data Feed basket

Data sources, collectors, and providers for the non-livestock sector

Non-livestock data are also annually collected and reported by the Ministry of Agriculture (MoA), through its Department of Agricultural and Extension Services (DAES). The main responsibility of the department is to promote crop production and improved human nutrition through the provision of agricultural extension services that advise farmers on improved farming systems and technologies. The overall aim is increased productivity and improved standard of living. There are other key sources of non-livestock data such as private companies. These main data sources and those that will be key sources as the Kingdom moves from Tier 1

to Tier 2 are summarised in Table 3 below.

Table 3: Main data providers for the non-livestock sector in Eswatini

Institution	**Department/Unit**	**Data**
MoA	Crop section - Department of Agricultural and Extension Services (DAES)	National crops data (hectarage and yield)
Central Statistics Office	Agriculture Data Unit	National census years data on crops data (hectarage and yield)
FAO		National crops data (hectarage and yield)
King's Office	Crops Section	Crops data from Tibiyo TakaNgwane farms (hectarage and yield)
Eswatini Revenue Authority	Imports and Exports	All imports for fertilizers, urea and lime
Eswatini Sugar Association		Sugarcane hectarage and yield for commercial and small-scale farmers
Royal Eswatini Sugar Corporation, Illovo and Tabankulu Farms		Sugarcane crop hectarage and yield N fertiliser, lime and urea applied
Eswatini Cane Growers Association (ECGA)		Sugarcane crop hectarage and yield N fertiliser, lime and urea applied
Eswatini Cotton Board		Cotton crop hectarage and yield N fertiliser, lime and urea applied
Eswatini National Maize Corporation		N fertiliser, lime and urea supplied to subsistence farmers
Rice farmers		Hectarage of rice cultivated, cultivation period and yield Pre, during and post season

		management practices
Eswatini Farmers Union (EFU), National Agricultural Marketing Board (NAMBOARD), Swaziland Farmers' Cooperative Union (SWAFCU) and ESAFF		Crop and vegetables hectarage and yield N fertiliser, lime and urea applied
Farm Chemicals, Swaziland Agricultural Suppliers and Triomf (N fertiliser suppliers)		N fertiliser supplied to local commercial and subsistence farmers
Eswatini Water Services Corporation (EWSC)		Quantities of sludge used as manure
Forest Plantation Companies		Crop hectarage and yield Amounts of N fertiliser, lime and urea applied to soils
Orchards (banana, pineapple, citrus, etc.)		Crop hectarage and yield Amounts of N fertiliser, lime and urea applied to soils

Data availability and gaps for the livestock sector

Data availability in the country is also largely influenced by land tenure. The title deed land (TDL), which constitutes 24% of the total land area is often characterised by high productivity, subsequently better management. On the contrary, a larger proportion of the livestock is found under Swazi Nation Land (SNL), approximately 75%, which suffers from low productivity and investment. With most of the data there are no official reports, and therefore expert judgement are currently the main source of data. Below is the list of available and missing data for the livestock sector in the Kingdom of Eswatini.

Available data for livestock sector
Data available includes:

- Livestock population data that are grouped by administrative regions and sub-regions are available nationally on annual basis from 2011.
- These national cattle population statistics are adequately disaggregated for Tier 2 (by type, i.e., dairy cows and beef cattle and by age (2-3 years, 1-2 years and < 1 year for both males and females)),
- There are other national statistics for goats, sheep, pigs, donkeys, horses, and poultry (indigenous, layers and broilers).

Missing data for livestock sector

There is a notable lack of data on the following:

- Livestock production systems:
  - No official documentation at a national level
  - Expert judgement is the current data source.
- Milk yields:
  - No data
  - Expert judgement currently used.
- Fat content of milk.
- Feed digestibility.
- Feeding conditions:
  - No data
  - Expert judgement currently used.
- Hours worked:
  - No data
  - Expert judgement currently used.
- Livestock unit (LSU) in Eswatini:
  - Current estimates do not take into consideration the breeds.
- Livestock weights and weight gains.

Table 4: A summary of activity data availability required for T2 and current data available

Parameter	Description	Cattle	Sheep/ Goats	Poultry
Population	Annual average population of each livestock sub-category.	✓	✓	✓
Livestock characterisation	Livestock sub-categories and characterisations per region	✓		✓
Body weight	Average live weight of each animal sub-category	✓*		
Mature weight	Shrunk body weight of mature animals	✓*		
Weigh gain	Average daily weight gain			
Body weight at weaning	Body weight at weaning	✓*		
Milk yield	Annual average daily milk yield per calendar year not per lactation	✓*	✓*	
Fat content of milk	Average fat content of milk (Apply to females)			
Fraction of adult	Fraction of adult females giving birth in a	P*		

females pregnant	calendar year	
Number of births	Number of births in a year (Does not apply to poultry)	
Feeding conditions	Categorization of animals as stall-fed, grazing confined pasture or grazing extensive rangeland	
Hours worked	Annual average number of hours of work per day (Applies to cattle)	✓*
Wool production	Wool production (Dry matter before scouring) per head per year	
Feed digestibility	Digestible energy as a percent of gross energy	
Fraction of manure managed in different systems	Fraction of manure from each type of livestock managed in different manure management system in different climate regions	✓*
Crude protein of diet	Average crude protein content of the diet	
Protein content of milk	Average protein content of milk	
Mean annual temperature	Mean annual temperature where livestock are located	✓

NB: A tick (✓) indicates that data are available, while a tick with a star (✓*) refers to expert judgement. Where there is no tick, data are unavailable

Data availability and gaps for the non-livestock sector

Available data for the non-livestock sector

Data available in the non-livestock sector include:

- Annual totals of imported N fertiliser
- Annual total of imported lime
- Annual totals of imported urea

Missing data for the non-livestock sector

There is noted lack of data as follows:

- Field-based manure management practices
- Field-specific data on N fertilizer application
- Field-specific data on lime application
- Field-specific data on urea application
- Cultivated rice hectarage

- Cultivated period of rice
- crop residue N
- Organic N applied as fertiliser (e.g., animal manure, compost etc.)
- Urine and dung N deposited on pasture, range, and paddock by grazing animals
- drainage/management of organic soils
- There are no emission factors for rice (harvested area and flooded fields), N_2O and lime emissions

Table 5. A summary of activity data availability required for T2

Parameter	Description	Maize	Sugarcane	Rice	Other
N fertiliser	Synthetic and organic fertiliser applied to soils				
Urea	amount of urea fertilisation				
Lime	amount of calcic limestone or dolomite				
Rice harvested area, and cultivation period	Cultivated period and the area under cultivation				
Rice water regimes	Ecosystem (i.e., irrigated, rainfed etc) type and flooding patterns				
Urine and dung N deposited	N deposited on pasture, range, and paddock soils by grazing animals				
Crop residue N	Crop residues (above-ground and below-ground),				
drainage/management of organic soils	area (ha) of drained/managed organic soils				

Protocols to acquire missing data

To address the issues of data availability in readiness for the T2EF (Tier 2 Emissions Factor) computation, the following are the proposed steps and/or protocols that are necessary to be established:

- Rangeland mapping integrating indigenous knowledge and community practices to enhance the definition of livestock productive systems. This can be done through

community engagement, especially with key informants in these communities.

- There is a need to rely on existing institutional structures within chiefdoms and integrated into the process for collecting data at community level.
- In addition, for data collected or that could potentially be collected by extension officers, it will be important to develop a system that is built on the existing institutional arrangements, such as the use of regional development areas (RDAs).
- There is a need to develop specific data collection templates for the livestock sector at the dip tank level that will enable emission estimation at the lowest possible level (data collection level). The same dip tank coverage areas should be used to record data during the annual livestock census, which will ensure continuity and all livestock data comparability. This must be achieved through the Department of Veterinary and Livestock Services in the Ministry of Agriculture (MoA), which is mandated to provide livestock extension services, manage government ranches, and provide animal nutrition and range management extension, among other duties.
- There is also a need to develop data collection templates for the non-livestock sector to collect data such as actual fertiliser applied instead of using data on imported fertiliser, crop residues etc. The imported fertiliser does not translate directly into fertiliser applied. That is, having data on imported fertiliser does not mean that all the imported fertiliser will be applied.
- Data collection plans, with timeframes, should be established. The introduction of the data collection and reporting templates at dip tank level, through MoA, ought to come with specific timelines for the collection and reporting/submission of data.
- Institutions such as the sugar industry and cotton industry that have kept data records over years need to be consulted on available data, gaps, and especially on developing the agreements to be established with them for data collection and data sharing.
- Policies, agreements and MOUs (Memoranda of Understanding) for data collection and sharing with data providers, such as private farms, should be developed and put in place. These will govern how data should be reported, i.e., format (templates), frequency, and the entity to report to.
- Encourage stakeholder workshops to discuss the data collection templates and plans, timelines, policies, and reporting templates.

References

Central Bank of Eswatini. (2021). *Economic Bulletin*. Mbabane, Eswatini: Ministry of Economic Planning and Development

Dlamini, W. D., Tfwala, S. S., & Mabaso, S. D. (2020). *AFOLU GHG Inventory*.

IPCC. (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. In. Hayama, Kanagawa, Japan: Institute for Global Environmental Strategies (IGES).

IPCC. (2021). *Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixthssessment Report of the Intergovernmental Panel on Climate Change*. C. U. Press.

Jackson, R. B., Saunois, M., Bousquet, P., Canadell, J. G., Poulter, B., Stavert, A. R., Bergamaschi, P., Niwa, Y., Segers, A., & Tsuruta, A. (2020). Increasing anthropogenic methane emissions arise equally from agricultural and fossil fuel sources. *Environmental Research Letters*, *15*(7), 071002. https://doi.org/10.1088/1748-9326/ab9ed2

Mhlanga-Ndlovu, B. s. F. N., & Mhlanga, N. (2019). *Building Capacity to Advance National Adaptation Planning Process in the Kingdom of Eswatini - Draft Report*. Mbabane, Eswatini

NCCC. (2015). *National Climate Change Committee Terms of Reference*. Mbabane, Eswatini

Wlikes, A., & van Dijk, S. (2018). *Tier 2 inventory approaches in the livestock sector: a collection of agricultural greenhouse gas inventory practices*.